USAWC STRATEGY RESEARCH PROJECT

FOR THE WANT OF A NAIL: U.S. DEPENDENCE ON FOREIGN OIL AND NATIONAL SECURITY

by

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ABSTRACT

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The current supply of relatively inexpensive and easily recovered oil is decreasing as new reserves are being found in increasingly remote or unstable areas, and new sources of oil are becoming progressively more difficult and costly to recover. As America's demand for foreign sources of oil increases, U.S. national security is increasingly vulnerable to interruptions of this supply from unstable states and non-state actors. The US needs to develop an aggressive, cohesive strategy to make itself less dependent on foreign sources of energy. This strategy must take a balanced approach of guaranteeing a secure supply, and reducing demand. As the global demand continues to increase, the competition for this supply will grow and the already strained oil infrastructure will become increasingly stressed. Conflict over the possession and control of vital economic goods - especially resources needed for the functioning of industrial societies will become a distinct possibility. This SRP will examine the U.S. use of oil, and make recommendations that may to be implemented to reduce America's dependence on foreign oil.

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FOR THE WANT OF A NAIL: U.S. DEPENDENCE ON FOREIGN OIL AND NATIONAL SECURITY

As America's demand for foreign sources of oil increases, U.S. national security becomes increasingly vulnerable to interruptions of this supply. Current energy policies are focused on maintaining the viability U.S. oil supplies, while only lightly addressing demand. This one-sided approach only serves to compound the problem. To reduce the threat to national security, the U.S. needs to equitably address the demand side of the energy equation. As the old refrain warns, "For the want of a nail the shoe was lost, for the want of a shoe the horse was lost, for the…. "

Without a continuous supply of energy, predominantly oil, the American and global economies are doomed. Individual prosperity and individual security will be threatened, and confidence in the government to protect the American way of life will erode. Lacking support of the people, the U.S. will be unable to project the ideals of prosperity and freedom leaving U.S. national security vulnerable. Henry Kissinger, then Secretary-of-state, echoed similar sentiments in 1975:

> …no issue is more basic to the future than the challenge of energy. The fundamental achievements of our economies, and the modern civilizations they sustain, have been built upon the ready availability of energy at reasonable prices.[1]

But this sage counsel has gone unheeded. The global economy is more reliant on non-renewable fossil fuels every day. In the nearly three decades since this speech, the U.S. has consistently failed to establish meaningful long-term energy legislation or energy policies.

Following the energy crises of the 1970s and the calls for conservation and reduction of oil dependency, the U.S. actually increased its imports from 43 percent in 1980, to over 60 percent in 2003.[2] From the Reagan administration through the current administration, U.S. National Security Strategies (NSS) have acknowledged the importance of energy imports, but have been overly focused on the necessity to maintain a continuous secure supply, and even espouse the need to use force. When the NSS does address conservation and alternative fuels, it is done in passive terms, and little or no meaningful legislation follows.[3] The current global supply of relatively inexpensive and easily recovered oil is decreasing and new reserves are being found in increasingly remote and/or politically unstable areas. These future sources of oil will become progressively more costly and difficult to recover, distribute, and secure.

Oil is now the world's principle source of energy providing nearly 40 percent of the global need-and this contribution is expected to remain relatively constant through 2025[4]. Oil is also the single largest sector of international trade.[5] These facts make oil the single most important

commodity of the global economy. While there is wide disagreement about the quantity of the actual global oil supply, many experts agree that oil will be available for the foreseeable future.[6] There is a larger issue regarding oil other than its supply. "The problem with oil is not its shortage, but rather its concentration".[7] Over 70 percent of the world's proven oil reserves are located in the unstable Middle East, and regulated by OPEC (Organization of Petroleum Exporting Countries).[8] This fact also makes oil a critically vulnerable commodity. OPEC can sell oil to many markets and can buy needed goods from many markets, but the U.S. is dependent on them for oil. This asymmetric dependency of products is the key to factor of U.S. national security vulnerability. As dependency increases, national security vulnerability increases.

This SRP will discuss the global; oil reserves, consumption trends, distribution infrastructure, and future demands. It will analyze current U.S. oil consumption and future trends, and provide an introduction to new or developed technologies that could provide alternatives to oil. It concludes with recommendations to reduce the U.S. dependence on foreign sources of oil minimizing the deleterious effects future oil interruptions could have on the U.S. economy.

OIL AND U.S. NATIONAL SECURITY

The key to U.S. national security is economic freedom and prosperity, these depend on a stable supply of oil, and *The National Security Strategy of the United States of America (2002)* makes this very clear. In the first paragraph President Bush states that;

> …In the twenty-first century, only nations that share a commitment to protecting basic human rights and guaranteeing political and economic freedom will be able to unleash the potential of their people and assure future prosperity.
>
> \- George W. Bush, The White House, September 17, 2002

The economy is the heartbeat of the American society and way of life. Energy keeps that heartbeat strong and oil is the blood it pumps. Energy, in one form or another, is required to accomplish nearly every aspect of every day life. Without energy, predominantly oil, the American way of life would simply not be possible. Section VI of *The National Security Strategy of the United States of America* (NSS) clearly connects the critical roles of energy and the global economy to U.S national security.[9] This strategy clearly articulates how the U.S. national security relies on much more than a strong defense. A thriving U.S. economy is the embodiment of the spirit of the American way of life; a strong economy supports political freedom, economic freedom, the unlimited potential of the people, and the projection of those ideas across the globe. Individual prosperity and security is the backbone of U.S. national security. The American

Military is and will likely remain without peer for the foreseeable future, but the threat to U.S. national security is increasing. In the words of Sun Tzu, "To subdue the enemy without fighting is the acme [peak] of skill."[10]

OIL AND THE U.S. NATIONAL ENERGY POLICY

The National Energy Policy (NEP) developed by the National Energy Policy Development Group (NEPD)[11] lays the groundwork for implementing the National Security Strategy as it applies to energy. But to this end it fails. It is filled with recommendations, many of which are too general to provide meaningful direction for the government as a whole to implement. With regard to U.S. oil consumption in the transportation sector, and current Corporate Average Fuel Economy (CAFE)[12] standards, the recommendations provide no guidance, relying instead on such tentative imperatives as "look at", "consider", "review" etc. Consider the following excerpt from Chapter 4 of the NEP Summary of Recommendations:

> The NEPD Group recommends that the President direct the Secretary of Transportation to:
>
> • Review and provide recommendations on establishing Corporate Average Fuel Economy (CAFE) standards with due consideration of the National Academy of Sciences study to be released in July 2001. Responsibly crafted CAFE standards should increase efficiency without negatively impacting the U.S. automotive industry. The determination of future fuel economy standards must therefore be addressed analytically and based on sound science.
>
> • Consider passenger safety, economic concerns, and disparate impact on the U.S. versus foreign fleet of automobiles.
>
> • Look at other market-based approaches to increasing the national average fuel economy of new motor vehicles.[13]

Those recommendations addressing the sector that uses the largest amount of oil are crafted so that the automotive industry is not required to make any substantive changes, and the oil industry will be guaranteed a large market in the near and distant future. The remainder of the NEP recommendations are crafted very similarly.

While they advance good ideas, in general the policy lacks any forceful language or enforcement mechanisms to affect the necessary changes. Indeed, decisions on oil, political concerns, and economics may not always be made in the greater national interest. Unfortunately, regardless of the political and economic agendas or motivations, the facts show the U.S. prefers policies of increasing and securing oil supplies to the detriment of policies reducing national oil demands. A more balanced approach to addressing the supply and demand of oil imports is needed to ensure American national security.

GLOBAL OIL RESERVES, CONSUMPTION, PRODUCTION, DISTRIBUTION

OIL RESERVES

The widely accepted estimate for total proven global oil reserves is on the order of 1,100 billion barrels. Of this, approximately seventy percent lies in the Middle East oil fields [14]. Figure 1 depicts the proven reserves for the last twenty years. It indicates that crude oil is becoming more difficult to find- and that most of the new oil is still being found in the OPEC countries.

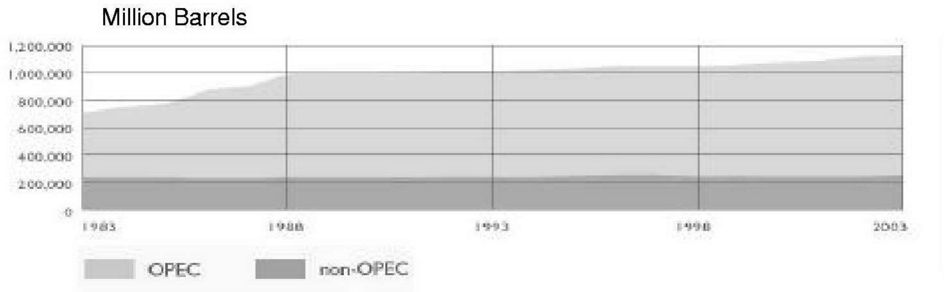

FIGURE 1. WORLD PROVEN CRUDE OIL RESERVES (1983-2003)[15]

Much has been made of the oil reserves discovered in the Caspian Sea region, but for the most part these have proven to be largely exaggerated claims. The accepted proven Caspian oil reserves are between 18-34 billion barrels, with possible reserves estimated at 293 billion barrels.[16] While there may yet be a great deal of oil found in the Caspian Sea region as exploration continues, access to it remains a major drawback. The Caspian Sea is landlocked, and all the oil and natural gas that comes from the region must be moved by pipelines. U.S. proven reserves are estimated at 24 billion barrels.[17]

But how much more oil is there to be found? In April 2000, the United States Geological Survey (USGS) released their report of a five-year study on global oil reserves. This report included a modern assessment by 40 geoscientists, with external reviews by petroleum industry firms throughout the process. This study also forecast world oil production. The mean (expected value) for ultimate oil recovery is 3,003 billion barrels.[18] Colin Campbell, a retired oil industry geologist, estimates that to date the world has used about 900 billion barrels.[19] While this would seem to assuage the fears of those who believe the world is about to run out of oil, new sources of oil will continue to be more difficult and costly to access and transport.

OIL CONSUMPTION

In 2001, the world consumed 77 million barrels of oil per day (MMBD)[20], which equates to 28 billion barrels per year. At this rate, simple math predicts exhaustion of the proved reserves in approximately 40 years. However, this calculation does not account for two important variables. First, energy demands will surely increase beyond the current rate. Second, oil will likely be used more efficiently, and alternative energy sources will surely be developed.

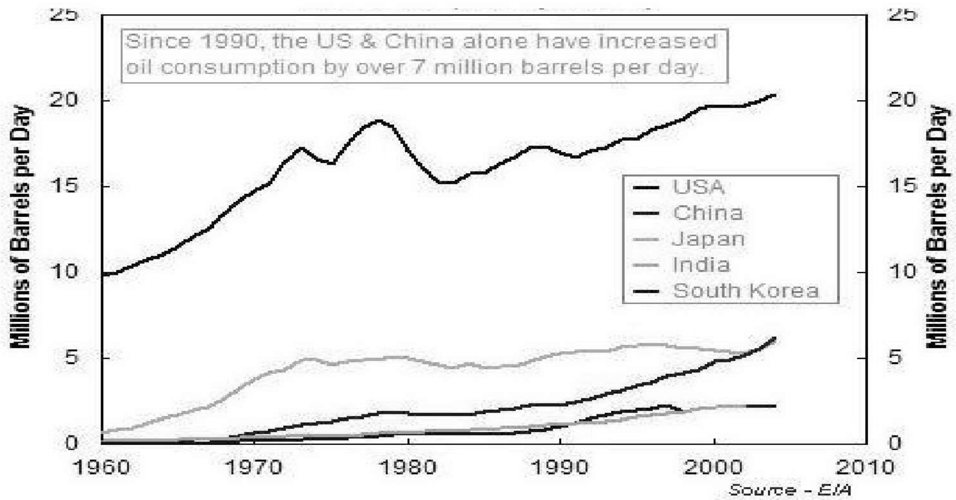

FIGURE 2. OIL CONSUMPTION BY COUNTRY[21]

Figure 2 shows the dramatic contrast between U.S. oil consumption and that of the world's most rapidly developing nations. First, it should be noted that the U.S. accounts for 25 percent of the global annual use. Secondly, and more importantly, the U.S. continues to increase its demand more rapidly than most of the other nations. The chart also shows that following three major crude oil disruptions in 1973, 1979, and 1990, all precipitated by events in the Middle East, the U.S. took actions to reduce demand. But these reductions were short-lived, and the U.S. oil usage became even greater. Global oil consumption continues to rise with seemingly little concern for the impact. The reason for this is oil's high energy density, ease of production, and low cost compared to other sources of energy. In 2003 global oil consumption increased 1.4 MMBD. Of this increase, developing Asian countries accounted for 81 percent.[22] By 2025 global consumption is expected to reach 121 MMBD or 44 billion barrels per year. With the transportation sector expected to account for an increasing share of this increase.[23] These predictions of increased energy use might portend faster oil depletion, excessive greenhouse

gasses, more energy shortages, and higher prices. But such predictions are far from certain. Smil (2003) demonstrates convincingly that these types of predictions for the last 100 years, with few notable exceptions, have been monumentally erroneous, even to the point of counter-productive.[24] The principal failure of these forecasts is their inability to accurately predict advances in technology. Improvements in efficiency, manufacturing, and recovery technologies have reduced the U.S. "Energy Intensity", the energy use per dollar of GDP, by 70 percent of its 1920 levels, and currently it stands at only 56 percent of 1970 levels (Figure 3). Japan and China have also reduced their energy intensities by 30 percent and 60 percent respectively.[25] Dramatic effects like these may not be sustainable, but technology should continue the trend.

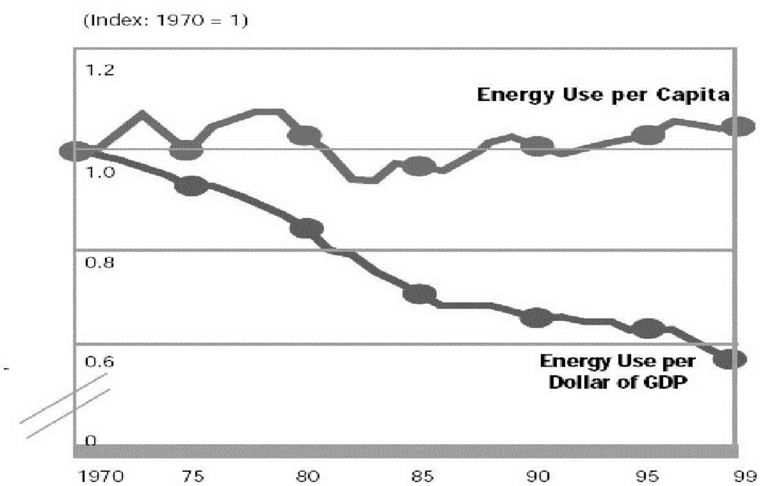

FIGURE 3. U.S. ENERGY INTENSITY1970-1999[26]

It is likely for this reason that full scale implementation of new energy technologies and forceful legislation in the U.S. has stalled. The lower the energy intensity the more dependent an economy is on inexpensive sources of energy. As energy costs increase, the effect would be to increase the cost to manufacture and use goods which in turn would have a stalling effect on the economy. Unilaterally requiring U.S. manufacturers and consumers to use more expensive types of alternative energies will have the same detrimental effects on the U.S. competitive position in the global economy.

PRODUCTION

Production of the global oil supply is primarily dependent on two factors: cost to produce, and cost of transport to market. For these reasons, the Persian Gulf is the principal source for the global oil supply. The cost to produce one barrel of oil in the Persian Gulf is the lowest in the world, around two dollars, and their cost to increase production is also low.[27] In addition to this cheap oil, the region offers easy access to ports for large tankers. Like all commodities, the price of oil is regulated by the laws of supply and demand. As the largest exporter of oil, OPEC controls much of the supply into the world market; hence it can largely control the price. Since their costs are low, it is in their interest and ability to control the price below that which makes it profitable for other suppliers who would otherwise increase their supply or invest in greater exploration, and below the price where alternative sources become competitive.

To predict future oil production, the Energy Information Agency (EIA) uses oil prices of between 17 dollars and 34 dollars per barrel. EIA world oil production estimates in Figure 4 predict a much greater increase in production for OPEC than other producers, simply because OPEC can produce and deliver oil less expensively than other sources over the long run.

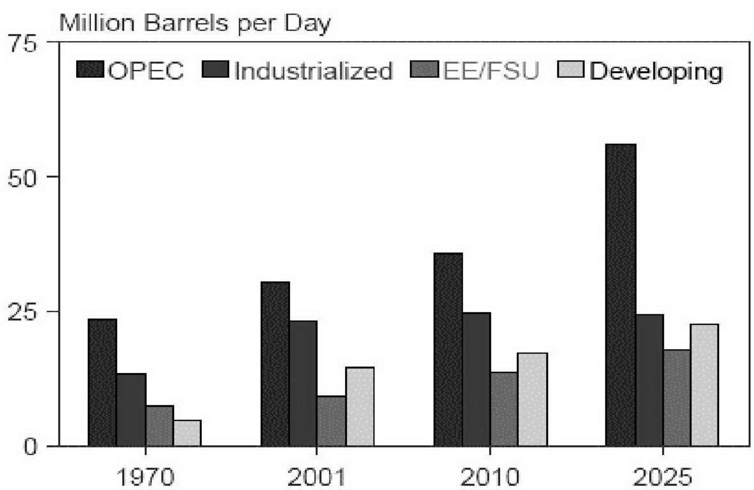

FIGURE 4. PROJECTED OIL PRODUCTION INCREASES TO 2025[28]

Nonetheless, the concentration of production in this region introduces a significant vulnerability to the supply of oil by forcing the global supply through few points. The reality of global oil

supply interruptions is well documented. Fifteen interruptions are listed in *Crude Awakenings* since 1954, including the current disruption of 2.6 MMBD as a result of the war in Iraq.[29]

As global demand for oil steadily increases, the excess global capacity decreases. One estimate puts the present global spare capacity at only about one million barrels a day, or 1.2 percent of global demand.[30] Much of the domestic U.S. oil is produced by off-shore oil rigs in the Gulf of Mexico. As recently as September 2004, a series of hurricanes had a dramatic impact on this U.S. oil production. The storms reduced production by 25 percent, with estimates of up to six months to return to full capability.[31] It is not surprising that when, as happened in the fall of 2004, a nexus of unrelated interruptions occurred- hurricanes in the Gulf of Mexico, wartime disruptions in Iraq, and fears of an oil worker strike in Nigeria, combined with increasing demand in China and tight heating fuel supplies -oil prices soared to over 53 dollars a barrel.[32]

DISTRIBUTION

Crude oil is moved principally by two means: pipelines and tankers. Worldwide, there are hundreds of thousands of miles of oil pipelines; over 139 thousand miles in the U.S. alone deliver over 13 billion barrels of products annually.[33] Up to 48 inches in diameter, these pipelines are vulnerable to disruptions from numerous sources. A study of American energy transportation concluded that;

> Although all forms of energy movements are vulnerable to some extent, pipelines are perhaps uniquely vulnerable. No other energy transportation mode moves so much energy, over such great distances, in a continuous stream whose continuity is so critical an aspect of its importance.[34]

The great majority of these pipelines are buried deep enough to protect them against all but the most determined saboteurs and terrorists. But pipelines are still vulnerable to earthquakes, to mechanical failures, and to industrial accidents. The portions that are above ground are vulnerable to attack. Over 50 percent of the 800-mile Trans-Alaska pipeline, which moves over two million barrels of oil a day, is above ground. It has been exposed to minor attacks and accidents during its lifespan.[35]

Oil tankers comprise the second leg of the oil distribution network. As with the extensive network of worldwide oil pipelines, providing security to the worlds 1500 tankers is in reality an impossible task. As Lovins (1982) describes it, "Once laden, tankers must run a gauntlet of narrow sea lanes where free passage is not always guaranteed."[36] This 1982 statement may be somewhat dramatic, but as terrorists have become more sophisticated in recent years, the warning becomes more relevant. Tankers at sea are vulnerable to attacks and piracy. In 1981 twenty-one tankers were boarded and robbed of crew valuables.[37] These attacks could as easily

seek to destroy the tankers. A tanker passes through the Straight of Hormuz every eleven minutes and the Cape of Good Hope every twenty minutes.[38] In military terms these choke-points, along with the Straights of Malacca, provide tempting terrorist targets. Blocking these passages could disrupt the global flow for significant periods of time. To the U.S. and the world economies, oil transport presents a major vulnerability. As President Carter has phrased it in 1979; "Our national well being depends heavily, upon a thin line of tankers stretching around the world to the Straight of Hormuz."[39]

U.S. OIL USAGE

TRANSPORTATION

The transportation sector of the U.S. economy is the greatest oil abuser; accounting for over 66 percent of the oil used in the U.S. Figure 5 indicates how U.S. petroleum was allocated in 2003. In 2003 45 percent, or 8.94 MMBD, was for refined motor gasoline alone. Of this, the U.S. imported 887 thousand barrels of oil per day of motor gasoline and blending components.[40] This demand should continue to increase as the economy grows and more drivers and vehicles take to U.S. highways. The CAFE standards established in the early 1980s resulted in a dramatic U.S. automobile fuel economy average, for automobiles, increase from 18.7 miles per gallon (mpg) in 1979 to 29 mpg in 2002.[41] But the same can not be said for Sport Utility Vehicles (SUV's) and light trucks.

The following analysis highlights the major failing of the current CAFE standards. Light trucks are currently classified as vehicles with a Gross Vehicle Weight Rating of under 8,500 pounds, along with other criteria.[42] These criteria allow SUV's to be classified as light trucks. In 1979 the fuel economy average was 19.3 mpg for domestic automobiles, and 17.7 for light trucks. The combined domestic fleet average fuel economy was 19.1 mpg. That year, light trucks made up only 9.8 percent of the total market. In 2002 the fuel economy average was 29 mpg for automobiles, and 21.3 mpg for light trucks. Here the CAFE policy has failed.

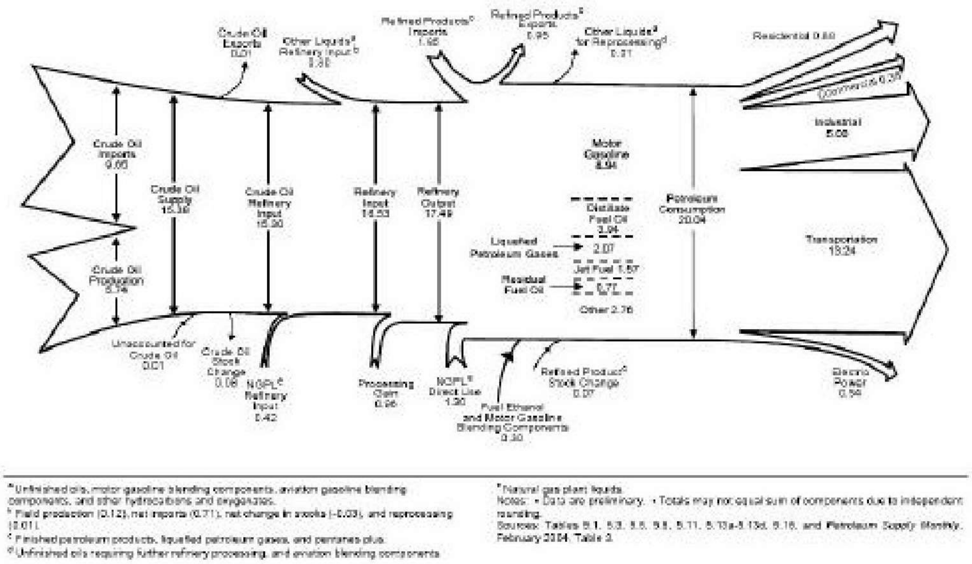

FIGURE 5. PETROLEUM FLOW 2003[43]

In 2002, the light truck share of the market had increased to 48.9 percent resulting in an overall fleet fuel economy average of 24.6 mpg. In fact, the combined fleet fuel economy average has been steadily decreasing since 1987 when it peaked at 26.2 mpg.[44] There are several reasons for this failing. First and foremost is the increase in popularity of the SUV's and light trucks -and the subsequent failure to address the issue when it occurred. Secondly, with Congressional appropriations frozen in 1996, the National Highway Transportation Safety Administration (NHTSA) was not authorized to conduct the required analysis for light trucks. Therefore the light truck standard has been frozen at 20.7 mpg since 1996.[45] Figure 6 highlights the failing of the current CAFE standards.

The fuel rates for both passenger cars and light trucks (vans, pickup trucks, and SUVs) increased commensurate with the established standards from 1978 through 1990. The passenger car CAFE standard has been constant at 27.5 mpg since 1990, and the graph indicates only a marginal mileage improvement since. The same can be said for the light truck fleet whose CAFE standard has remained at 20.7 mpg since 1996. This failing is further amplified by a nearly steady increase in miles driven over the period. As of 2001, there were over 138 million were passenger cars and over 84 million were light trucks on U.S. highways.[46] When all of this information is combined with the increase in the number of vehicles on the road today, and the large percentage of those being light trucks, it is easy to conclude that the U.S. congress shows little concern for adequately addressing this issue.

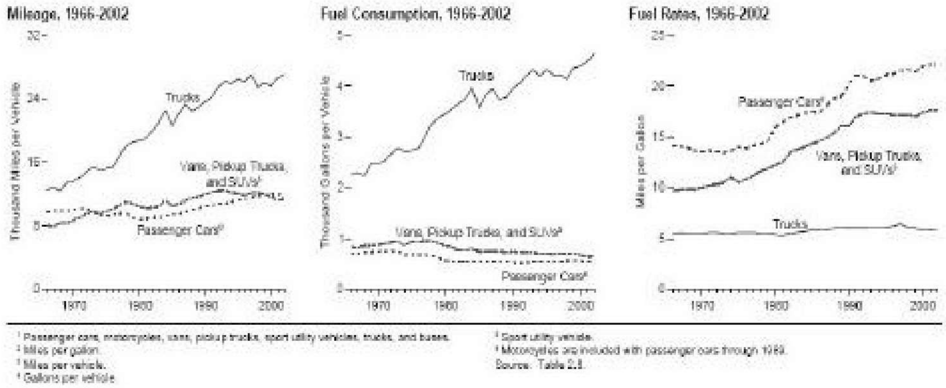

FIGURE 6. U.S. FUEL CONSUMPTION/FUEL RATES 1966-2002[47]

The remaining fuel in the transportation sector is used as diesel fuel for the trucking industry and jet fuel in the air transportation industry. The nearly exclusive use of long haul trucks to move goods throughout the country reflect the obvious failure to develop an efficient economically viable rail system. While little improvement in overall oil usage would be realized in improving the mileage of commercial trucking, converting the industry to alternative fuels such as bio-diesel, and development of an efficient commercial rail system could have a measurable effect on oil use as a fuel.

OIL ALTERNATIVES

COAL AND CLEAN COAL TECHNOLOGIES

There is more than enough coal to supply the world's energy needs for the foreseeable future. Worldwide coal reserves are estimated at 770 billion tons, but this estimate is based on detailed exploration of less than ten percent of known deposits.[48] In the U.S. alone, 92 percent of the coal used produces nearly 53 percent of all electrical power.[49] Despite its abundance and extensive U.S. reserves, carbon dioxide emissions, acid rain, and air pollution resulting from burning coal prevent the industry from realizing its full potential.[50]Research into "clean coal" technologies are making the future of the coal industry more viable and will help reduce U.S. dependence on foreign oil imports.

Clean coal technologies include power generation and production of clean fuels such as methanol. Demonstrations of several successful "clean coal" technologies have been completed in recent years. Pressurized Fluidized Bed Combustion (PFBC)[51], Integrated Gasification

Combined Cycle (IGCC)[52], and the Liquid–Phase Methanol Process (LPMEOH™).[53] Each of these technologies is designed to reduce the toxic emissions produced from burning or processing of coal.

NUCLEAR

Nuclear fission reactors produce electricity without emitting greenhouse gasses or other air pollutants. Not without its drawbacks, nuclear energy is an ideal choice for the future. Expansion of the nuclear energy industry is advocated in the current National Energy Policy.[54] In an attempt to overcome the public aversion to nuclear power, the industry embarked on a strategy to make nuclear energy acceptable. Central to this strategy was the development of advanced designs and standardized engineering along with a reformed licensing process. These efforts help reduce costs that plagued the "custom built" power plants of the 70s and 80s and help restore public confidence in nuclear energy.[55]

ALTERNATIVE FUELS

An "alternative fuel" is one primarily designed for internal combustion engine vehicles. There are a relatively large number of these fuels; propane, natural gas, bio-diesel, ethanol, methanol, electricity, hydrogen, and coal derived liquids. As a result of the "Alternative Fuels Act of 1988", which promoted federal government acquisition of alternative fueled vehicles, the federal government and numerous municipalities have implemented programs to use these type vehicles and prove the technologies.

The major problems common to each of these fuels is that they have lower energy densities than gasoline meaning a lower gasoline-equivalent-gallon. Current alternative fueled vehicles have limited range and are not adequately supported by a refueling infrastructure. These problems combined with higher vehicle costs and the limited fuel cost savings, have made these vehicles undesirable to the overall public.[56]

GAS TO LIQUID

The process known as Fischer-Tropsch (F-T) is named for the German scientist that invented it in 1923. The process converts methane gas in a reaction with carbon monoxide into a liquid that can be further refined into a sulfur-free clean burning fuel. The F-T process could tap the vast stranded gas reserves, waste gas from refineries, methane from coal, or methane from undersea methane-hydrates could be used. It is estimated that a fifty thousand barrel per day plant would be profitable with crude oil prices at $17 a barrel.[57]

FUEL CELLS

The National Energy policy recommends the development of fuel celled vehicles:

> The NEPD Group recommends that the President direct the Secretary of the Treasury to work with Congress on legislation to increase energy efficiency with a tax credit for fuel-efficient vehicles. The NEPD Group recommends that a temporary, efficiency-based income tax credit be available for purchase of new hybrid fuel cell vehicles between 2002 and 2007.[58]

The Department of Energy (DOE) estimates that commercially viable PEM (Proton Exchange Membrane) or hydrogen fuel-cell vehicles could be available between 2015 and 2020.[59] However, several major technical problems remain: cost, component durability, safe hydrogen storage, and limited power. Solving these technical problems will require a significant investment. In January 2002, Secretary of Energy Abraham announced a partnership with the automobile industry to promote development of fuel-cell vehicles.[60] In 2001, the U.S. invested slightly over 110 million dollars in government research and development in these vehicles, while Japan invested over 130 million. The difference in corporate research is more pronounced; while the Japanese government/corporate investment totaled 400 million dollars, the U.S. joint investment totaled just over 200 million.[61] This lack of funding in research and development only further indicates the lack of interest in realistically reducing the nation's demand for global oil.

ECONOMIC IMPACTS

Every sector of the current global economy is driven by the need for plentiful and inexpensive supplies of oil. The relationship between oil price and the viability of alternatives is relatively simple. With the price of oil low, and supplies plentiful there is no economic incentive to substitute a more expensive fuel. As the price of oil rises the more expensive alternative fuels and economically dry oil fields become economically viable[62]. This is the delicate balance every global industry makes on a continual basis. It is the corporation and the country that is best positioned and has the long term vision to manage this balance that is the most secure. Those that fail to prepare will be the most vulnerable to the volatile.

Another issue that must concern the U.S. and the rest of the world is a failure of the global oil industry to supply the needed amount of crude oil and natural gas to fuel the world's economies. Modern history is replete with examples of interruptions to this supply, none more vivid to the U.S. than shortfalls resulting from the 1973 oil embargo or the 1979 Iranian revolution. These relatively small interruptions of six to eight percent caused oil prices to quadruple and inflation and unemployment to skyrocket.[63] These situations dramatically

demonstrate why the U.S. must reduce its dependence on foreign oil by seeking a dramatic reduction of America's insatiable petroleum demand.

"Oil prices remain an important macroeconomic variable;"[64] The recent report by the International Energy Agency (2004) offers a demonstrable connection between oil price increases, GDP, inflation, and unemployment.[65] And while these economists argue over the finer points of macroeconomics, the actual significance is lost on the population that must deal with the day-to-day impacts of oil prices. Indeed the price of oil affects the well-being of the economy; increases in oil prices lead to consumer price index inflation, increases in the producer price index, and overall inflation. The recent increase in oil prices to over fifty dollars a barrel affected the average consumer greatly. The immediate impact pushed gas prices up fifty cents a gallon. For the typical driver, that could quickly relate into an extra fifty dollars each month for gasoline. Food prices rise as well, as product transportation costs are passed on to consumers. This cycle will continue until there is relief. Home heating costs will rise dramatically adding another fifty cents to a gallon of heating oil. In the first quarter of 2004 consumer spending grew at 4.1 percent; but in the second quarter, as gas prices reached two dollars a gallon, consumer spending grew at only 1.6 percent. This came at a time when many economists were "not concerned" with the rapidly rising oil prices. The net result is a tax on the consumer that goes back to the oil exporting countries, leaving less money for consumers to spend on discretionary goods and services in the United States.[66] This translates into less corporate taxes for the Treasury, and less funds available to the government for its programs. This means further deficit spending, weakening of the U.S. dollar, and further erosion of national security. This recent example ominously shows how any major disruption would amplify these impacts.

RECOMMENDATIONS

The U.S. needs to develop a cost effective, aggressive, and cohesive strategy to make itself less dependent on foreign sources of energy. This strategy should be balanced to ensure a secure supply and to reduce demand. This strategy can be achieved by encouraging research and development in oil recovery technologies, by reducing oil-fired power generation plants, by continuing to make improvements in efficiencies and conservation programs, and by reducing the nation's transportation systems dependency on oil.

The biggest gains will be made in reducing the demand from the transportation system, principally in the gasoline market sector. As noted, 45 percent of U.S. oil consumption, 8.9 MMBD- is in the form of refined gasoline. This represents 73 percent of U.S. annual oil imports.

Since 1979, total U.S. oil usage has increased by 1,531 MMBD; during the same period, U.S. refined gasoline demand increased 1,860 MMBD.[67] This problem is not a U.S. problem alone, but a global problem, and one that must be reversed. To accomplish this, the NTHSA must change the current CAFE standards to begin reducing the demand for gasoline. Lifting the appropriations freeze in 2001 has allowed the NHTSA to address light truck CAFE standards for the first time in five years. In 2004 the NHTSA mandated an incremental increase in light truck fuel economy from the present 20.7 mpg to 22.2 in 2007.[68] However, this will have only a marginal effect on overall fuel usage. The following recommendations will substantially reduce America's dependence on foreign oil;

Recommendations to reduce demand:

1. Reclassify the SUV fleet as automobiles not light trucks, with incremental fuel economy improvements implemented over 10 years. Senate Bill S.255 was introduced to address this, but it has languished since January 2003.[69]
2. Increase the automobile CAFE standard for the combined vehicle fleet to 40 mpg within the next 10 years. A similar proposal was introduced in the early 1980's to address the post 1985 CAFE standards.[70] However, the bill lacked support and died.
3. Convert all U.S. electrical power generation to clean coal, nuclear, and renewable (i.e. solar, wind) power plants.
4. Continue to update the requirements for efficient municipal electrical use and appliance energy usage. More efficient lighting, electrical devices, and home thermal efficiencies are significant contributors to the continual improvements in "energy intensity".

Recommendations to enhance U.S. oil supply:

1. The U.S. Government should provide incentives for domestic oil exploration and oil recovery technologies from economically exhausted wells.
2. Congress should enact regulations that limit the endless litigation that delays domestic exploration and production when proven technologies are used that minimize environmental impacts.

Recommendations that improve supply and reduce demand:

1. Develop fuel-celled powered vehicles: Such vehicles offer the optimal solution if their technical disadvantages of power and range can be overcome. Production of hydrogen

could be accomplished by self-contained home units using solar energy, thereby nearly eliminating fuel costs.

2. Increase investment in alternative fuels and alternatively fueled vehicles, with an ultimate goal of converting all vehicles to alternative fuels in the future. Producing liquid fuels for vehicle use from coal and gas would alone almost eliminate the need for oil imports.

What is needed to accomplish these recommendations is enlightened political leadership, investment, capital, research, and effective legislation to support them. Over the years a great deal of legislation has been introduced that would adequately address many issues, but these initiatives have been rendered largely ineffective by Congressional lobbies and pork barrel politics. Fixing the current outdated CAFE standards should be the first step in reducing the U.S. dependency on foreign oil. Several technologies currently exist that can be implemented to improve mileage.[71] Dedicated research and development in fuel-cells, alternative fuels, and the vehicles that are powered by them is needed to permanently reduce the transportation sector's global demand.

However, in free market economies, corporate research expenditures in advanced technologies to reduce crude oil demand will remain low as long as the price of crude oil is low. The transition from oil to new fuels will not be as simple or quick as was the conversion from whale oil to kerosene for lighting; and replacing a fuel distribution network that has been developed over decades, while not technically challenging, will be time-consuming and expensive. Continuing to delay or limit the necessary research into new fuels will only exacerbate the negative effects of rising oil costs, the detrimental effects of supply interruptions on the economy, and national security issues.

CONCLUSION

U.S. national security requires much more than the employment of U.S. armed forces. The U.S. infrastructure is an intricate organism of critical systems all working in concert to support the greatest democratic society on the earth. In most cases, should one of these systems fail, or part of a system fail, such as a major bridge crossing or a power generating station, there is enough redundancy to ensure only minor inconveniences. The one system that does not have sufficient redundancy is the current system to supply, refine, and deliver crude oil and crude oil products when they are needed, where they are needed, and in the quantities that are needed. It is easy to view oil as the national lifeblood, pipelines as the arteries, and refineries as the heart that moves the entire organism. But it is critical to acknowledge that a

major extended disruption in the nation's oil supply would cause the U.S. economy to grind to a halt. Soon thereafter, the global economy would begin to decline in a rapid and catastrophic fashion through a progressive cascade of interdependent events. As a result of modern "globalization", this destabilization of the U.S. economy would result in a collapse of the entire global financial system, with comparable world wide effects. Then severe conflicts would erupt around the globe as people begin fighting for the diminishing resources. The world would see a fundamental shift in power to those with secure oil supplies and the ability to maintain their economy.

With the current limited excess capacity of global oil production, the minor disruptions of 2004 should be a reminder how dependent the world economy is on a continuously secure flow of oil. While the preceding scenarios may seem extreme, the issues that are posted daily on the front pages of newspapers around the country- greenhouse gasses, $5 a gallon gasoline, celebrity trials, ecological concerns - all pale in comparison to the real problems that will quickly arise if the U.S. and the rest of the world continue the tremendous waste of this precious resource. The U.S. should take the leadership role in developing the aforementioned alternative energy sources. Development of these alternate sources now; will reduce the energy cost at which they become viable substitutes, and minimize the economic impacts across the entire spectrum of applications.

The U.S. and the world would do well to pay heed to the following famous quotation from American History:

> For the want of a nail, the shoe was lost; for the want of a shoe the horse was lost; and for the want of a horse the rider was lost, being overtaken and slain by the enemy, all for the want of care about a horseshoe nail.
>
> \- Benjamin Franklin

Franklin's prophetic observation forces us to admit that the coveted barrel of oil has become the global economy's "horseshoe nail".

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ENDNOTES

[1] Henry Kissinger, "Energy: Toward a New Cooperative Era" (Speech given before the meeting of the ministerial level of the International Energy Agengy, Paris, France, 29 May 1975, according to the text released by Bureau of Public Affairs, U.S. Department of State, Washington D.C.), 1. excerpted from Howard Bucknell, *Energy and the national Defense*. (Lexington, KY.: The University Press of Kentucky, 1981), 107.

[2] Energy Information Administration, *Annual Energy Review 2003* (Washington, D.C., U.S. Government Printing Office, 13 September 2004), 122; available from <http://www.eia.doe.gov /emeu/aer/contents.html>. Internet; accessed 15 September 2004.

[3] Ronald Reagan, *The National Security Strategy of the United States of America*. (Washington, D.C.: The White House, September 1988),12. In the 1988 NSS; Energy is an important underpinning to our economic industrial and military strength, and thus to our national security. Over the long term, our national energy policy is aimed at ensuring adequate supplies of energy at reasonable prices by strengthening domestic energy industries, diversifying energy sources, and proving energy efficiency. We are working through the International Energy Agency to assist our Allies to develop complimentary strategies. More immediate objectives are to reduce the nation's vulnerabilities to disruptions in foreign energy supplies and to lessen the impact on the civil economy if disruptions should occur. This includes plans for increasing the size of the Strategic Petroleum Reserve, promoting international cooperation with the Allies and partners in the International Energy Agency and encouraging research into economically viable tech-nologies that increase energy efficiency or that make use of alternative sources of power. See Also William Clinton, *The National Security Strategy of the United States of America*. (Washington, D.C.: The White House, September 1995), 21.In the 1995 NSS; The United States depends on oil for more than 40% of its primary energy needs. Roughly 40% of our oil needs are met with imports, and a large share of these imports come from the Persian Gulf area. The experiences of the two oil shocks and the Gulf War show that an interruption of one supplies can have a significant impact on the economies of the United States and its Allies. Appropriate economic responses can substantially mitigate the balance of payments and inflationary impacts of oil shock; appropriate foreign policy responses to events such as Iraq's invasion of Kuwait can limit the magnitude of the crises. Over the longer term the United States dependence on access to the four were all sources will be increasingly important is our resources are depleted. The U.S. economy has grown roughly 75% since the first oil shock yet during that time are oil consumption has remained virtually stable and oil production has declined. High oil prices did not generate enough new oil expiration and discovery to sustain production levels from our depleted resource base. The facts show the need for continued an extended reliance on energy efficiency and conversation and development of alternative energy sources. Conservation measures notwithstanding the U.S. has a vital interest in unrestricted access to this critical resource. Additionally in, George Bush, *The National Security Strategy of the United States of America*. (Washington, D.C.: The White House, September 2000), 34. In the 2000 NSS; The United States depends on oil for about 40% of its primary energy needs, and roughly half of our oil needs are met with imports. Although we import less than 15% of the oil exported from the Persian Gulf, our Allies in Europe and Asia account for about 80% of those exports. For some years, the United States has been undergoing a fundamental shift away from reliance on Middle East oil. Venezuela is consistently one of our top foreign suppliers, and Africa now supplies 15% of our imported oil. Canada , Mexico and Venezuela combined supply almost twice as much oil to United States as the Arab OPEC countries. The Caspian basin with potential oil reserves of 160 billion barrels also promises to play an increasingly important role in

meeting rising world energy demand in coming decades. Conservation measures and research leading to greater energy efficiency and alternative fuels are critical element of the U.S. strategy for energy security. Our research must continue to focus on developing highly energy efficient buildings, appliances, and transportation and industrial systems, shifting them were possible to alternative or renewable fuels such as hydrogen, fuel cell technology, ethanol, or methanol from biomass. Conservation and energy research notwithstanding, the United States will continue to have a vital interest in ensuring access to foreign oil sources. We must continually be mindful of the need for regional stability and security and keep producing areas as well as our ability to use our naval power, if necessary, to ensure access to and the free flow of these resources. And in, George Bush, *The National Security Strategy of the United States of America*. (Washington, D.C.: The White House, September 2002), 19.The 2002 NSS; We will strengthen our own energy security and the shared prosperity to the global economy by working with our allies, trading partners, and energy producers to expand the sources and types of global energy supplied, especially in the western hemisphere, Africa, Central Asia, and the Caspian Region. We will also continue to work with our partners to develop cleaner and more energy efficient technologies.

[4] Steve Yetiv, *Crude Awakenings: Global Oil Security and American Foreign* Policy (Ithaca, NY: Cornell University Press, 2004), 1.

[5] Ibid.,17.

[6] One expert discusses a 200-year supply, but at unknown prices. [Richard Mancke, *The Failure of U.S. Energy Policy* (New York: Columbia University Press, 1974), 11.]. Others believe that long before oil is exhausted, the combinations of price, environmental concerns, and technology will force societies to develop alternate sources. This coercive phenomenon has been labeled "adaptive cornucopian". [Vaclav Smil, Energy at the Crossroads: Global Perspectives and Uncertainties (Cambridge,MA: The MIT Press, 2003), 186.]. Yet there is no end to those that predict the coming end of the world's oil supply: Some predict the end as early as 2030 to justify the need for energy conservation and development of alternative energy sources. [Colin Mason, *The 2030 Spike: Countdown to Global Catastrophe* (London: Earthscan, 2003), 11.]

[7] "Oil and Geopolitics: Crude Arguments," *The Economist* (9 October 2004): 77.

[8] Lincoln Bloomfield, Jr., *Global Markets and National Interests: The New Geopolitics of Energy, Capital, and Information* (Washington D.C.: The CSIS Press, 2002), 56.

[9] George Bush, *The National Security Strategy of the United States of America*. (Washington, D.C.: The White House, September 2002),,17-20. In his NSS, President bush makes the connection of oil to national security in the following paragraphs. "A strong world economy enhances our national security by advancing prosperity and freedom in the rest of the world. Economic growth supported by free trade and free markets creates new jobs and higher incomes. It allows people to lift their lives out of poverty, spurs economic and legal reform, and the fight against corruption and it reinforces the habits of liberty."

"We will strengthen our own energy security and the shared prosperity to the global economy by working with our allies, trading partners, and energy producers to expand the sources and types of global energy supplied, especially in the western hemisphere, Africa,

Central Asia, and the Caspian Region. We will also continue to work with our partners to develop cleaner and more energy efficient technologies."

[10] Sun Tzu, *The Art of War*. Translated and with an Introduction by Samuel B. Griffith. (London: Oxford University Press ,1963), 77.

[11] The National Energy Policy Development Group (NEPD) was commissioned by President Bush early in his first term of office to develop a national energy policy.

[12] The Corporate Average Fuel Economy (CAFE) standards were enacted in congress in 1975 as a result of the 1974-1975 oil embargo. There are different standards for automobiles and light trucks, or those with a gross vehicle weight rating of 8500 pounds or less. These standards are determined by the National Highway Traffic Safety Administration based on an analysis of technology, and economics that is funded by congress.

[13] Dick Cheney, *National Energy Policy: Report of the National Energy Policy Development Group* (Washington, D.C.: U.S. Government printing Office, May 2001), Ch.4 – p.11.

[14]Energy Information Administration, *World Proved Reserves of oil and Natural Gas, Most Recent Estimates* (Washington, D.C.: U.S. Government Printing Office, 9 November 2004); available from <http://www.eia.doe.gov/emeu/international/reserves.html>. Internet; accessed 12 November 2004.

[15]OPEC Website, *OPEC Annual Statistical Bulletin 2003.* (Vienna, Austria: 2004). 35; available from <http://www.opec.org/Publications/AB/pdf/AB002003.pdf>. Internet; accessed 29 September 2004.

[16]Bernard Gelb, *Caspian Oil and Gas: Production & Prospects RS21190* (Washington, D.C.: Congressional Research Service, The Library of Congress, 9 April 2002), CRS-2

[17] Energy Information Administration, *Annual Energy Review 2003*, 95.

[18]John Wood, Gary Long, and David Morehouse, *Long-Term World Oil Supply Scenarios; The future is Neither as Bleak or Rosy as Some Assert* (Energy Information Administration, Washington, D.C.: U.S. Government Printing Office, 18 August 2004), Table-1; available from <http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2004/worldoilsupply/oilsupply04.html>. Internet; accessed 12 November 2004.

[19]Jeffrey Ball, "As Prices Soar, Doomsayers Provoke Debate on Oil's Future", *The Wall Street Journal*, 21 September 2004. Sec. A. p.14.

[20] Energy Information Administration, *International Energy Outlook 2004* (Washington, D.C.: U.S. Government Printing Office, April 2004), 167; available from <http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2004).pdf>. Internet; accessed 12 November 2004.

[21] Barry Ritholtz. "Global Crude Oil Demand & Gasoline ", (*The Big Picure*, 29 September 2004), np; available from <http://bigpicture.tyepad.com/comments/2004/09/crude_oil_gasol.html>. Internet; accessed 12 November 2004.

[22] Energy Information Administration, *International Energy Outlook 2004*, 27.

[23] Ibid., 28.

[24] Vaclav Smil, Energy at the Crossroads: Global Perspectives and Uncertainties (Cambridge,MA: The MIT Press, 2003),121-180. He attributes the recent power outages crisis in California on the inability to adequately forecast energy needs. The high economic growth in the 1970's resulted in many new electrical plants to be built. However, because of conservation efforts and other efficiency measures these plants became economic liabilities. No new plants were built, and the resulting energy shortages ensued.

[25] Ibid., 158-160.

[26] Dick Cheney, *National Energy Policy: Report of the National Energy Policy Development Group*. (Washington, D.C.: U.S. Government printing Office, May 2001), ch.1 - p.4.

[27] Energy Information Administration, *International Energy Outlook 2004*, 38.

[28] Ibid., 35.

[29] Yetiv, 11.

[30] Robert Gold, "Deep Trouble: Far Below Gulf's Surface, Ivan Wreaked Havoc on Oil Industry" *The Wall Street Journal*, (27 October 2004): Sec. A p.1. [database on-line]; available from ProQuest; accessed 28 October 2004.

[31] Ibid.

[32] Reuters MSNBC.com, "Oil Prices Hit $53 a Barrel in Supply Fears: Officials Begin to Express Concern about Economic Impact." (7 October 2004), np; available from <http//www.msnbc.com /id/5612507>. Internet; accessed 7 October 2004.

[33] "Oil Pipelines", *Oil and Gas Journal, no.102* (23 August 2004): 71. [database on-line]; available from ProQuest; accessed 28 October 2004.

[34] Amory Lovins and Hunter Lovins. *Brittle Power: Energy Strategy for National Security*. (Andover, MA: Brick House Publishing Company, 1982),113.

[35] Alyeska Pipeline Co. Website, available from <http://www.alyeska-pipe.com/ PipelineFacts/pipelineoperations.html>. Internet; accessed 22 September 2004.

[36] Lovins, 105.

[37] Ibid.

[38] Bucknell, 126.

[39] Ibid., 60.

[40] Energy Information Administration, *International Energy Outlook 2004,* 127.

[41] U.S. Department of Transportation, National Highway Traffic Safety Administration, *Automotive Fuel Economy Program: Annual Update Calendar Year 2002,* 19; available from

<www.nhtsa.dot.gov/cars/rules/cafe/FuelEconUpdates/2002/index.htm>. Internet; accessed 8 October 2004.

[42] U.S. Department of Transportation, National Highway Traffic Safety Administration, *CAFE Overview: Frequently asked Questions*, 3; available from <www.nhtsa.dot.gov/cars /rules/cafe/overview.htm>. Internet; accessed 8 October 2004.

[43] Energy Information Administration,*International Energy Outlook 2004*, 121.

[44] U.S. Department of Transportation, National Highway Traffic Safety Administration, *Automotive Fuel Economy Program: Annual Update Calendar Year 2002,* 20.

[45] U.S. Department of Transportation, National Highway Traffic Safety Administration, *CAFE Overview: Frequently asked Questions*, 14.

[46] U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2003,* BTS02-08, (Washington, D.C., U.S. Government Printing Office, March 2003), Table 1-11; available from <http://www.bts.gov/publications/ national_transportation_statistics/2003 /index.html>. Internet; accessed 27 September 2004.

[47] Energy Information Administration, *Annual Energy Review 2003,* 56.

[48] Smil, 229.

[49] Energy Information Administration, *Annual Energy Review 2003,* 151.

[50] [28]Energy Information Administration, *U.S. Coal Supply and Demand: 2003 Review* (Washington D.C., U.S. Government Printing Office, 13 September 2004), 5; available from <http://www.eia.doe.gov/cneaf/coal/page/special/feature.html>. Internet; accessed 28 September 2004.

[51]Pressurized Fluidized Bed Combustion (PFBC) burns coal in a slurry consisting of a coal-water fuel paste, coal ask, and dolomite or limestone absorbent. The process reduces sulfur and nitrous emissions, and was demonstrated by the Ohio Power Company2004 National Energy Technology Laboratory. *Clean Coal Compendium; Tidd PFBC Demonstration Project,* (20 January 2004), 1; available from <http://www. netl.doe.gov/cctc /factsheets/tidd /tidddemo.html>. Internet; accessed 6 October, 2004.

[52]Integrated Gasification Combined Cycle (IGCC) technology produces a coal gas that is then burned to produce steam for turbines demonstrated by the Sierra Pacific Power Company. 2004 National Energy Technology Laboratory, *Clean Coal Compendium ;Pinon Pine IGCC Power Project,* (20 January 2004), 1; available from <http://www. netl.doe.gov/cctc /factsheets /pinon/pinondemo.html>. Internet; accessed 6 October, 2004.

[53]Liquid - Phase Methanol Process (LPMEOH™) technology produces methanol from coal which can be used for fuel or chemical production, demonstrated by Air Products and chemicals. 2004 National Energy Technology Laboratory, *Clean Coal Compendium ;Comercial-Scale Demonstration ot the Liquid-Phase Methanol (LPMEOH™) process,* (20 January 2004), 1; available from <http://www.netl.doe.gov/cctc /factsheets/estm/csliqiddemo.html>.Internet; accessed 6 October, 2004.

[54] Cheney, *National Energy Policy.*, ch.5.-p.17.

[55] Ronald Simard, "*The New Institutional and Regulatory Framework for the Next Generation of U.S. Nuclear Power* Plants. (Nuclear Energy Institute, Washington, D.C., 2004), np; available from <http://www.worldenergy.org/wec-geis/publications/default tech_papers/ 17th_congress/3_4_11.asp#Heading1>. Internet; accessed 12 December 2004.

[56] Brent Yacobucci, *Alternative Transportation Fuels and Vehicles: Energy, Environment and Development Issues*. (Washington, D.C.: Congressional Research Service, The Library of Congress, Updated 30 June 2004), CRS 1-24.

[57] Peter Reina, "Process Engineers See Promise in a Century-Old Technology. " *Engineering News Review*, no.248, (June 2002),10; [database on-line]; available from ProQuest; accessed 5 October 2004.

[58] Cheney, ch.4-p.12.

[59] Department of Commerce, Office of Technology Policy Technology Administration, *Fuel Cell Vehicles: Race to a New Automotive Future* (U.S.Government Printing Office, January 2003), 22; available from <http://www.technology.gov/reports/TechPolicy/CD117a-030129.pdf>. Internet; accessed 8 October 2004.

[60] Ibid., 30.

[61] Ibid., 28.

[62] An economically dry oil field is a field where production costs exceed the value of oil recovered. As the price for a barrel of increases, the value of oil recovered may make this "dry" field economically productive.

[63]Daniel Yergin and Joseph Stanislaw, *The command Heights: The Battle for the World Economy* (New York: Simon and Schuster, 2002), 46.

[64] "Analysis of the Impact of High Oil Prices on the Global Economy" *International Energy Agency*, Paris Fr., (May 2004), 15; available from <http://www.iea.org/Textbase/Papers/2004/ High_Oil_Prices.pdf>. Internet; accessed 23 September 2004.

[65] Ibid., 2-9.

[66] Bruce Nussbaumm "…Wrong. You Can't Ignore $50 a Barrel ", *Business Week NY*, no. 3903, (11 October 2004): np.[database on-line]; available from Proquest; accessed 28 October 2004, 50.

[67] Energy Information Administration, *Annual Energy Review 2003,* 150.

[68] U.S. Department of Transportation, National Highway Traffic Safety Administration, *CAFE Overview: Frequently asked Questions*, 4.

[69]Robert Bamberger, *Energy Policy: The Continuing Debate*. (Washington, D.C.: Congressional Research Service, The Library of Congress 17 March, 2003), CRS-6.

[70] Frank von Hipple, “Fourty Miles a Gallon by 1995 at the Least!: Why the U.S. Needs a New Automotive Fuel Economy Goal,” in *The Dependence Dilemma: Gasoline Consumption and Americas Security*, ed. Daniel Yergin (Cambridge, MA: Center for International Affairs, Harvard University, 1980), 93.

[71] Patrick Gosselin, Cost And Benefits Of The Gasoline Direct Injection Engine, (Ottawa: Office of Energy Efficiency Natural Resources ,17 April, 1998); available from <http://oee.nrcan.gc.ca/english/programs/Doc3e.cfm>. Internet; accessed 20 December 2004. One promising improvements is gasoline direct injection. Instead of using a fuel injection system that injects fuel at low pressures into the engine manifold, direct injection injects the fuel directly into the engine combustion chamber at high pressure greatly increasing power, and fuel economy. See also: Scott Memmer, *CVT Enters the Mainstream,* available from <http://www.edmunds.com/ownership/ techcenter/articles/45104/article.html>. Internet; accessed 20 December 2004. Another development is the continuously variable automatic transmission which allows the engine to operate at more efficient speeds again improving mileage

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